

The study of this very complete and suggestive memoir cannot fail to increase the regret which must be universally felt in the scientific world at the death, so early in his career, of its distinguished author.

J. W. J.

READABLE BOOKS IN NATURAL KNOWLEDGE.

Wonders of Physical Science. By E. E. Fournier. Pp. viii+201.

Tillers of the Ground. By Dr. Marion I. Newbigin. Pp. viii+224.

Threads in the Web of Life. By Margaret R. Thomson and Prof. J. Arthur Thomson. Pp. vii+198. (London: Macmillan and Co., Ltd., 1910.) Price 1s. 6d. each.

SOME years ago a new series of "Readable Books in Natural Knowledge" would have been a gift of doubtful value to the teacher. Written by the capable hands that have made the present volumes, they could not have failed to awaken here and there the genuine passion for scientific inquiry, and so would have seemed to justify their existence. But, speaking generally, the more completely such books had succeeded in "popularising" the labours of the *savant* the further they would have been held to direct the attention of the teacher from the proper aim of instruction in science. We now recognise that that aim is not so much to make the pupil acquainted with certain ranges of facts as to train him in the exercise of one of the most important forms of human activity. Thanks largely to the tireless propaganda of Prof. Armstrong, this aim is at present pursued with more or less intelligence wherever it is claimed that science is being taught. The boy learns that the essence of science consists in putting a clear question to nature and wresting from her a clear answer to it. In favourable circumstances he acquires some of the mental habits essential to success in this pursuit, or at any rate is made to see that such success comes only of faithfulness and labour.

It was natural that the training value of heuristic methods should be emphasised by their advocates since this element was almost entirely absent from the older didactic methods. But modern pedagogy, instructed by the results of psychological inquiry, has become critical of the claims of a subject to train or cultivate "faculties," and prefers to find in the nature of the subject itself the justification for teaching it. Thus the prime reason for teaching science is that, intrinsically and in its results, the scientific activity is one of the greatest and worthiest types of human effort. An education that does not give a sympathetic acquaintance with it is, therefore, necessarily incomplete. Whatever other arguments may be urged in their favour, heuristic methods in science teaching are rendered necessary by the fact that by them alone the pupil is made actually to exercise the scientific activity, and so to gain direct knowledge of one of the cardinal forms of human achievement. But when by first-hand experience he has genuine knowledge of the scientific activity, he should also have opportunities of appreciating its significance in human history. It is

NO. 2128, VOL. 84]

precisely to serve this function that the present series of "Readable Books" has been designed. To quote the publishers' note, they "aim at exalting the scientific spirit which leads men to devote their lives to the advancement of natural knowledge, and at showing how the human race eventually reaps the benefit of such research."

It may be said at once that in the first three books of the series this aim has been already admirably fulfilled. The authors have approached their task in the right temper, and have, on the whole, been remarkably happy, both in the choice and in the treatment of their topics. Mr. Fournier takes ground, a great part of which has been worked over by predecessors, but he has evidently gone himself to the works of the great physicists, and his chapters have the freshness and force derived from this direct contact. Dr. Marion Newbigin tells of the evolution and spread of food-plants with an epical directness and unity of plan. An episode in the development of Transatlantic commercialism—such as the transportation of Smyrna figs to California—becomes in her hands a wonderfully impressive illustration of the working of the scientific spirit. Mrs. and Prof. J. A. Thomson have taken a subject which hardly lends itself to the same unity of treatment. In part, their object is to exhibit the dependence of man upon deliberate or unconscious partnership with animals—such as the domesticated animals on the one hand, and earthworms on the other. They come nearer to the special aim of the series in the chapters where they show what tremendous results depend upon the scientific investigation of the life-histories of microscopic parasites. It is unnecessary to say that both parts of their programme are admirably executed.

A notable characteristic of each of the books is that they bring the tale of scientific conquests down to our own days. Thus Mr. Fournier describes Röntgen's discovery of the X-rays, and tells the story of aviation down to Blériot's flight across the Channel last year. Dr. Newbigin gives capital chapters on the work of Mendel, de Vries, and their followers. Prof. and Mrs. Thomson have a chapter on the relation between mosquitoes and malaria, as well as one on Pasteur. In short, these most interesting and stimulating little books initiate a series which will at once prove of great value as an adjunct to the systematic instruction of the class-room and laboratory, and, if continued in the same spirit and with the same ability, will become an almost indispensable part of a school equipment for science teaching.

T. P. N.

SALMON AND TROUT.

Life-history and Habits of the Salmon, Sea-trout, Trout, and other Fresh-water Fish. By P. D. Malloch. Pp. xvi+263. (London: Adam and Charles Black, 1910.) Price 10s. 6d. net.

THIS book is almost entirely devoted to the salmon of the Tay, sea-trout, and brown trout. "The other fresh-water fish" are but slightly dealt with, and the chapters allocated to them call for no particular notice, save to direct attention to the start-

lingly inaccurate assertion that "Prof. Grassi, of Rome, discovered the breeding grounds (of the eel) to be out in the Atlantic Ocean from Norway, Denmark, France, and Spain in some parts 1000 miles from shore."

With salmon and trout the case is different; any work upon this subject by a fisherman and fishery manager of Mr. Malloch's experience cannot fail to be of interest. Some readers will doubtless not be prepared to accept in their entirety all the views advanced, but all will be grateful to the author for recording the conclusions which he has drawn from a very wide personal experience.

The most interesting feature of the book is the really excellent series of illustrations, reproduced from photographs of Tay salmon of all ages and conditions, and of sea-trout and brown trout from various rivers and lochs. Illustrations such as these give a far better impression of the changes due to growth and condition and the variations caused by environment than any letterpress. The investigations of the Scottish Fishery Board and the Department of Agriculture in Ireland have familiarised us with the great individual difference in the period spent by salmon in the sea, and Mr. Malloch figures salmon which were marked as smolts and subsequently re-captured on their return to the river after a longer or shorter sojourn in the sea, and discusses the probable length of such sojourn. He expresses himself as "fully convinced that many (Tay) fish from 40 lb. and upwards are on their first return from the sea when they are captured in fresh water"; we could wish that some definite evidence were forthcoming in support of this conviction, for a 40-lb. salmon is presumably eight, or at least seven, years old, and Calderwood has stated that "it appears to be somewhat unusual for a fish to remain till its fourth sea year" (*i.e.* its sixth year) "without spawning."

In the Tay, salmon run at all seasons of the year, and Mr. Malloch is of opinion that the clean winter fish which run in October remain thirteen months in fresh water before spawning. We must confess to feeling sceptical on this point, more particularly as there seems to be nothing to show that such fish may not drop back again to the sea after a short sojourn in fresh water without spawning. In the case of the Blackwater (mentioned in this context as a spring river) there is some positive evidence that clean early-spring fish do drop back into the sea.

The opinion now generally held that the "bull-trout" of the Tay is a salmon is confirmed by an illustration of such a fish side by side with a salmon of the same size and weight; we understand Mr. Malloch to regard "bull-trout" as salmon which have spawned and again ascended the river as mended fish, a view which seems hardly consonant with that held by Calderwood, though not inconsistent with the results of some of the marking experiments conducted by the Scottish Fishery Board. It cannot, of course, be seriously suggested that all salmon, after once spawning, become "bull-trout."

Some space is, very properly, given to a consideration of the deductions to be drawn from an examina-

tion of the scales of salmon. While the figures given by Mr. Malloch are excellent, we find his explanations in the text rather difficult to follow; the generalisation that a salmon adds sixteen rings to its scale in each year of its life, so long as it feeds and grows, is not borne out by the scales figured or by the observations of other persons; the two years spent as a parr and smolt would, in fact, seem to account for a number of rings, varying from about twenty to twenty-seven, while from twenty to thirty rings may be added in any subsequent year spent wholly in the sea.

Such matters as the spawning and feeding of salmon in fresh water and their movements in tidal rivers are briefly discussed, and interesting figures are given of land-locked salmon up to three-quarters of a pound in weight.

Did space permit we would willingly quote freely from the chapters dealing with sea-trout and brown trout, and in particular from a most interesting discussion of the effect of environment on the latter fish, and the lessons to be drawn therefrom in the stocking and management of fisheries.

In conclusion we must deplore the entire absence of either index or detailed table of contents.

L. W. B.

NON-EUCLIDEAN GEOMETRY.

Theories of Parallelism: an Historical Critique. By W. B. Frankland. Pp. xviii+70. (Cambridge: University Press, 1910.) Price 3s. net.

THE appearance of this tract is a welcome sign of the growing interest in the foundations of geometry. Those who, greatly daring, first disputed or denied Euclid's fifth postulate were treated, if not as charlatans, at least as idle speculators, whose theories, even if sound in the abstract, had no relation to actual space. It may be added that the earlier works on the non-Euclidean geometries were not very attractive to the average mathematician, because they were either so analytical that the reader was inclined to regard their geometrical interpretation as a mere *façon de parler*, or so vague and intuitive as to raise a suspicion of want of rigour.

Things have altered so much, not in substance, but in mode of presentation, that it may fairly be said that anyone with a knowledge of spherical trigonometry and elementary calculus may satisfy himself of the validity and coordinate rank of the elliptic, hyperbolic, and parabolic (or Euclidean) geometries; and he could hardly wish for a better introduction to the subject than that which Mr. Frankland has provided.

The tract falls naturally into three parts. The first, with remarkable brevity and clearness, gives the principal formulæ derived from the assumptions that the area of a polygon of n sides is proportional to the difference between the sum of its interior angles and $(n-2)\pi$, and that Euclidean geometry holds for infinitesimal figures. The second part gives, in separate paragraphs, short accounts of forty contributors to the theory, ranging from Euclid to Dodgson. This list seems fairly complete, with one noteworthy exception—Sophus Lie. In the third volume of his "Theorie der Transformationsgruppen" (section v.) Lie gives a